Interdisciplinarity and the new governance of universities

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1) Interdisciplinarity by organizational decree?

For decades the call for interdisciplinarity has permeated discourses in science and higher education policy in reaction to an ever faster specialization and institutional differentiation of research and teaching. Yet, it had little or no effect neither on the level of organization nor on that of actual conduct of researchers and teachers. Now there are signs that this may change. Some universities begin to pioneer structural changes that seem to give substance to the notion of interdisciplinarity by giving it organizational reality. But in most, structural obstacles remain in place. Previous general appeals for 'interdisciplinarity' were already reactions to the perceived crisis of science's overspecialization and its distance from society. In another respect, however, this is novel insofar as the demand for interdisciplinarity is now translated into organizational changes within universities. Changing the organizational structures by facilitating or even incentivizing intellectual exchange and cooperation across disciplinary boundaries may go beyond the hitherto vacuous plea for interdisciplinarity. But there are epistemic obstacles that rest in the nature of disciplines as both, strongly institutionalized forms of knowledge production and organizational structures such as departments or faculties at the same time. In view of their dual nature, i.e. their epistemic and their social self-referentiality they cannot not be changed easily.

In fact, questions as to what extent knowledge production is an autonomous enterprise or to what extent it is determined from outside, which are the units of science that shape the course of knowledge production, and on what level of the social organization of science do 'external' problems become problems of scientific research have been at the heart of the sociology of science for a long time (Whitley 1984; Stichweh 1984; Becher/Trowler 1989; Knorr-Cetina 1999; Gläser 2006). The answers are diverse, dependent on theoretical perspectives and categories employed. There is general agreement, however, that some units, e.g. disciplines, are more stable, i.e. self-directed, than others, e.g. specialties. Disciplines are institutionalized as units of teaching and change less rapidly than specialized fields that are primarily driven by research.

When interdisciplinarity is called for two types can be distinguished. First, interdisciplinary research fields that result from re-combination of specialties, i.e. from within science, for example through the application of methods from one field to the subject matter of another as in molecular biology. Ultimately they assume the same organizational mode of 'internal

specialization' and become a specialty of their own. Second, interdisciplinary (or transdisciplinary) research promoted from outside, i.e. by political bodies, research councils or funding agencies in order to direct research to politically desired objectives and/or to nudge scientists to cooperate across disciplinary boundaries where they normally would not, e.g. because of career considerations. Examples of this kind of interdisciplinarity are climate research or security research. They are combinations of specialized research fields from different disciplines, joined in research centers, funding programs, journals and networks (cf. Weingart 2010, 14).

Most commonly the sociological analyses of the units of knowledge production regard disciplines as 'intellectually' autonomous and look outward for 'social' influences. The reverse is rarely asked: if and how societal challenges – e.g. environmental protection or global warming – become defined as subject matters of scientific inquiry and established as research fields. Since they inadvertently build on the stock of existing knowledge they are, at least initially, conglomerates of disciplinary 'knowledges'. In the strict sense of the term they are multi- rather than interdisciplinary. If they become inter-disciplinary in the ambitious sense of the term depends on whether the disciplinary methods, theories, models and concepts can be integrated to create truly 'added value', i.e. new knowledge. They would then resemble the re-combination of specialties initiated from 'within' and become specialties by themselves.

Both types of 'interdisciplinarity' may meet with the resistance from university departments for similar reasons. Interdisciplinarity is an innovation that cannot be judged on the basis of the accepted disciplinary criteria of quality. That is an epistemological reason. The new research field usually competes with established ones for resources. Since disciplines or departments are also 'interest groups' they defend vested interests attached to established practices, recruiting and career patterns as well as labor markets. That is a social reason. In any case: Even though their business is the production of new knowledge disciplines are very conservative in their operations.

In light of that it is all the more surprising that a growing number of universities claim to reform themselves by transforming the traditional disciplinary department structures. The move is made possible by their becoming entrepreneurial organizations with stronger central administrations. But the motivation seems to be that they respond to outside challenges, be it a perceived loss of legitimacy because of their distance to society, be it a reaction to funding programs that call for new profiles. How successful are these moves in the sense of establishing new research fields outside and beyond the existing disciplinary department

structure? What keeps the rear guard from advancing more courageously? Does the move towards interdisciplinary organizational structures in universities even signal a fundamental change in the organization of knowledge production?

Thus, the issue is if, although initially undertaken as legitimating exercises, it is imaginable that the structural reforms create 'interdisciplinarity by default'. I will probe the different advances both by universities and science policy agencies to establish organizational structures as means to facilitate the response to outside challenges. Some observers interpret these attempts as indication that 'discipline' as the dominating form of knowledge production is likely to be replaced. I will remain a bit more cautious: by providing organizational mechanisms that irritate disciplinary closure and allow for the take-up of topics from outside universities respond to a crisis of trust. But these new structures typically meet with formidable opposition from departments or faculties respectively.

2) Interdisciplinarity 1.0

Part of the founding myth of the University of Bielefeld and its Center for Interdisciplinary Research (ZiF) is the reference to 'interdisciplinarity' as a guiding principle. As can be expected, the form it had taken upon its opening in November 1969 was achieved by an amalgam of original ideas emerging over a period of five years under the influence of intellectual, personal and political contingencies. Even the founder himself, Helmut Schelsky, was not precise regarding what interdisciplinarity meant for the structure of the university. What he foresaw was an accelerating specialization of science, the organization of research in large organizations, and thus the need for re-integration of science in theoretical research embracing the disciplines. This type of research was to be carried out in 'institutes of advanced study'. Without going into further detail regarding this story, thereby doing injustice to the personalities involved, it must be said that some of the original ideas failed under the impact of the reality of mass higher education, others remained half-baked like the so-called 'university foci', i.e. interdisciplinary centers.[1] The university centers did not survive for either or both of two reasons: because their subject matters were not chosen in response to 'real challenges' from outside academia and/or because the discipline-based structure of the university makes the centers extremely vulnerable to conflicts as they lack political support

[1] ('Schwerpunkte' in the language of the time) or interdisciplinary centers: Latin-America Studies, Mathematization of the Sciences, and Science of Science or Science Studies as it came to be named. They had no systematic place in the discipline-bound university organization of 'faculties'. Two of them led a zombie existence for many years and eventually died a slow death, only the latter survived when finally in 1993 the university senate agreed to establish it as an interdisciplinary institute. At the end of 2012 it, too, was closed. ZiF from the beginning on began a life (almost) of its own, but that is another story.

from the central administration. Insofar the development of this university with its early focus on interdisciplinarity reflects all the problems that characterize the issue at hand. It remains to note that one response of the German universities to the ‘excellence initiative’, the funding program that was to introduce competition between them, was the establishment of ‘institutes of advanced stududy’ as means to facilitate interdisciplinarity.

In 1972 the OECD’s Center for Educational Research and Innovation (CERI) published a report ‘Interdisciplinarity – Problems of Teaching and Research in Universities’. Among the contributions was a short article by the Austrian systems theoretician Erich Jantsch who not only coined the now fashionable term ‘transdisciplinarity’, but also developed a vision of a future university based on a radical epistemological turn: “a partisan viewpoint which starts from the assumption that man has become the chief actor in the process of shaping and controlling the system”, i.e. the system of human society and its environment (Jantsch, 1972, 103). The crucial point is: his “anthropomorphic viewpoint which by definition cannot be ‘objective’” implied a radical departure from the dominant view of science as the representation of the world *as it is.* Instead, he conceived the generation of new knowledge as well as its dissemination by teaching as *teleological* and *normative*, the organization of science as the basis for creative human action would shift more and more to interdisciplinary approaches. At the time Jantsch saw the first steps toward normative interdisciplinarity in experimental university programs that integrated education, research and service (Jantsch, 1972, 113). The structure of the transdisciplinary university had three layers: *systems design laboratories* devoted to themes such as “Ecological Systems in Man-Made Environments” or “Public Health Systems”, *function-oriented departments* that take an outcome-oriented look at the functions technology performs in societal systems, such as “Housing” or “Urban Distribution”, and finally discipline-oriented departments. For the educational function of the university he envisaged an enormous gain in flexibility. Rather than being bound to disciplines and the acquisition of knowledge per se (‘know-how’), function-oriented departments would focus on ‘know-what’. Discipline-oriented departments would be motivated to emphasize 'know-why' rather than ‘know-how’. Some students would go through discipline- and function-oriented departments, while others would continue up to the transdisciplinary design labs, not necessarily sequentially but going back and forth. The structure of education, i.e. the curriculum, would essentially be detached from the structure of disciplines and oriented to the highly ambitious function of socio-technical engineering (118).

Some of this sound nostalgic to our ears, reminiscent of the social engineering and planning enthusiasm of the 1960s and 70s, but some was clearly visionary. Jantsch has been forgotten because his ideas were too radical for his time, they came too early. In the higher education and science policy discourses, 'interdisciplinarity' gained considerable prominence but largely without any consequences on the level of research organization, curriculum structure or university management. The efforts of funding agencies to induce interdisciplinary research in the name of creativity, innovativeness and social relevance were, more often than not, undermined or evaded by re-labeling maneuvers. Interdisciplinarity remained a vacuous, multi-purpose concept in the respective discourses because it had no scientific urgency – no pressure on the supply-side – and little political urgency because the linear image of disciplinary research as the basis of innovation dominated all thinking about science in general and universities in particular. As a science or higher education policy concept, 'interdisciplinarity' found no counterpart in research or teaching. Quite the contrary: specialization and differentiation in the production and dissemination of knowledge continued unabated. Not until much more recently can one observe changes in some universities that seem to indicate a move toward more sustained 'interdisciplinary' structures. They are triggered both within science and in its social and political environment.

3) Interdisciplinarity 2.0?

In April 2011 the newly elected president of the University of Siegen, a provincial German university not very visible in rankings, embarked on what was announced to be a bold experiment. Backed by the advice from an expert committee, the board of trustees and the university senate re-structured 12 departments into four faculties. While the disciplinary structures still persist within them, to the outside the faculties are theme-oriented, in line with the university's overall guiding motto: "Man interacting responsibly with his future, focused on his power to influence this future". (It does not sound better in German either). This definitely reminds one of Erich Jantsch's vision, i.e. a reflexive approach to socio-technical systems and practice. The central element of the reform concept at Siegen is the foundation of a 'Research Center' (so-called Forschungskolleg) under the 'mission statement': 'To design the future humanely' ("Zukunft menschlich gestalten"). The authors insist that this is a true 'program' and not just a "vacuous and popular label". To support that claim they identify thematic fields, show their interrelations and their consequences for political practice as organizing principles for research in the center (Rektorat Siegen 2011).

The example is instructive not because it is pioneering university development, nor because of its success or failure – at this time we know of neither – but for two other reasons: 1) the attempt is made to formulate a mission statement in such a way that it has internal organizational consequences. The establishment of thematic centers is the crucial test case of university reform 'beyond faculties' everywhere. 2) the entire program is given an explicitly normative and practical orientation. In essence that means that interdisciplinarity no longer remains a perfunctory concept. Rather, it is intended to inform structural reforms and to guide research. Interestingly, the organizational form chosen is also that of an institute of advanced study. It remains to be seen if this example and various other similar ones will be sustained. It is actually hard to imagine that focused research programs can emanate from the very general overarching title of the research center's thematic fields.

The latter example of the University of Siegen is just one of several. A 2012 report by the 'Donors' Association for German Science' (Stifterverband), titled 'Beyond Faculties' ('Jenseits der Fakultäten') took a close look at various 'new organizational units beyond faculties' in German universities, apparently finding the accumulation of such units worth a separate study.[2] It classifies four organizational units for research: cross-faculty graduate programs and graduate schools; large research projects or centers (e.g. Research Clusters and Clusters of Excellence funded by the German Research Foundation – DFG); research units oriented to knowledge transfer to industry, and Centers for Advanced Study (Stifterverband 2012, 6). Similarly the report identifies seven different species of new organizational units for teaching, among them 'interdisciplinary teaching and research units geared towards professional fields (e.g. professional schools or teacher training centres)' (ibid., 8). According to the survey, 83% of the universities have graduate programs, 80% have research units across faculties, 40% have units with an external partner (industrial, public-private-partnerships PPP), 51% feature strategic units cooperating with external research institutions, and 29% have institutes for advanced study (ibid. 31). When asked if research and teaching is expected to be oriented to transdisciplinary topics in the near future, 76% of all higher education institutions answer that they believe this to be probable or very likely in the next few years (ibid., 94). If such expectations may be considered an indicator of likely developments, one can suspect a sustained trend. But, given the remarkable institutional stability of disciplines as the structural basis of universities, fundamental changes are improbable unless the causes are profound. The question then is: what has triggered this development, to which problems does

[2] The report is based on an online survey among 99 German universities (35) and 'technical' or 'universities of applied sciences' (64 Fachhochschulen). The response rate was 32% and considered highly representative.

it respond? And in view of the international character of disciplines: is it limited to the specific incentives of a national science and higher education policy or is it more widespread? It is obviously impossible to answer these questions here empirically, but some observations backed by theoretical considerations are a first step.

First of all: even though we have no way to say how widespread the movement is, it may be claimed that the development described for Germany is not confined to that country but can be witnessed in other countries as well.[3] One, albeit admittedly weak, indicator is the attention given to the topic in academic discourse. By 2007 almost 8000 articles had been published using the term 'interdisciplinarity' and pertinent research had grown steadily (Jacobs/Frickel 2009, 46). Somewhat more focused are the concerns of science policy. The NSF has commissioned a study of interdisciplinary research centers and programs which stated in 2003: "We also see the National Academies as well as individual national scholarly associations from the American Geophysical Union and the American Chemical Society to the American Institute for Biological Sciences and the American Political Science Association—sponsoring interdisciplinary analyses and emphasizing interdisciplinary activities at the borders of their represented sciences and disciplines. And, we find academic institutions from Harvard to Haverford proclaiming 'the need for academic and interdisciplinary change and innovation' to 'foster and enable collaboration among the faculties . . . to advance understanding of complex problems' (cited: Harvard University 2003; Haverford 1999)" (Rhoten 2003). Creso Sà observes: "Interdisciplinarity has become a laudable goal for federal agencies, scientific associations, industry, and academic leaders in the U.S. Proponents contend that academic institutions risk impairing scientific advancement and diminishing the contributions of science to society by retaining traditional organizational forms and modes of work associated with disciplinary specialization... A sense that the 'needed' science does not follow from the ways of organizing research in academia underlies federal, state, and philanthropic funding of interdisciplinary centers…" (Sá 2008, 537).

Thus, the promotion of interdisciplinary research, in particular, has been a concern of the U.S. National Academy's Committees on Facilitating Interdisciplinary Research (CFIR) and on Science, Engineering, and Public Policy (COSEPUP) (NAS 2004). The NAS report 'Facilitating Interdisciplinary Research' states: "A newer structure (of universities – PW), *which can already be discerned both in the United States and abroad* and which has long been evident in industry and elsewhere, is more like a matrix, in which people move freely among disciplinary departments that are bridged and linked by interdisciplinary centers,

[3] Two examples elsewhere, Arizona State University and University College Maastricht, are being described in more detail in this volume.

offices, programs, courses, and curricula. There are many possible forms of coupling between departments and centers, including appointments, salary lines, distribution of indirect-cost returns, teaching assignments and course-teaching credits, curricula, and degree-granting" (NAS 2004, 172, my italics). The report lists numerous examples of newly founded colleges in the U.S. as well as the well-known ones: "There are models of interdisciplinarity in all venues of scholarship. Rockefeller University is organized around its laboratories…; the Institute for Advanced Study in Princeton, New Jersey, admits only postgraduate 'visiting members' who are free to pursue independent study and develop collaborations as they choose" (ibid.,175). Rockefeller University has been recognized as a long standing example of a higher education institution whose interdisciplinary structure has made it exceptionally innovative in research (Hollingsworth/Hollingsworth 2000). These examples may suffice as evidence that the interest in interdisciplinarity has become more focused as a problem of universities' organization. But what were the motivations to pursue the necessary reforms, or in institutional terms, what were the causes that blew new life into the quest for interdisciplinarity?

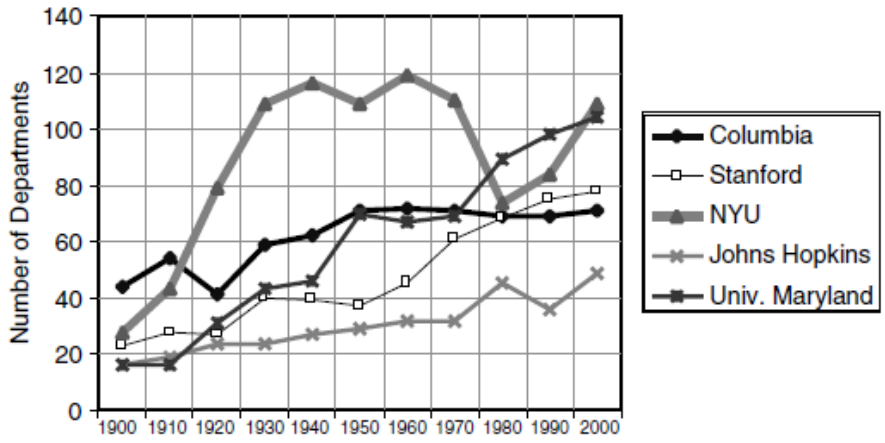
The above distinction between 'internal' and 'external' causes must be differentiated further: 1) internal developments of the disciplines that lead to their cooperation or fusion; 2) strategies of universities in response to financial and/or political incentives that suggest internal structural re-arrangements; 3) external developments such as the demand for 'value for money' of research, of an intensified innovativeness and improved technology transfer etc. Of course, these causes are not exclusionary but interdependent or at least mutually reinforcing.

Ad 1) The continued specialization of disciplines increases the likelihood of re-combinations of disciplines. This is corroborated by several findings. For Germany the differentiation of professional societies shows the following picture:

Source: Weingart, Schwechheimer 2007.

The development of disciplinary differentiation exhibited in the graph hides some peculiarities such as the extraordinary growth of medical societies, the explanation of which is not relevant here. However, the relatively less dynamic specialization in areas like physics or chemistry does not show the fact that these professional societies are differentiated internally. This differentiation often follows with a time lag. Thus, the formation of a section 'biochemistry' within the 'Society of German Chemists' occurred only in the 1980s, long after the field had come into existence. The study also shows an increase of inter- or multidisciplinary associations mostly in the broader fields of medicine and biology. It has to be cautioned that this "observation is based on self-descriptions which may reflect an adaptation to political expectations" (Schwechheimer, Weingart, 2007, pp.194-195). Another important point in this connection: these encompassing associations primarily occur in applied fields.

For the U.S., the NAS report states that the "number of departments has increased steadily over the last century, from about 20 in 1900 to between 50 and 110 in 2000. National professional societies have also increased in number from 82 in 1900 to 367 in 1985. Although those changes may appear to indicate increasing specialization~~,~~ the increases in new departments, such as biophysics and biochemistry, and societies, such as neuroscience and photonics, reflect a blending of previously distinct fields" (NAS 2004, 19 notes).



Source: NAS 2004, 19.

When considering these data it has to be noted that ‘discipline’ means many things, from the definition of subject matters, the classification of professional societies and the demarcation of academic degrees to the naming of departments or faculties and the subject catalogues of funding organizations, and their delineations are far from identical (Weingart, Schwechheimer 2007). Nonetheless, although amalgamations or fusions of disciplines do occur, they are relatively rare compared to the general trend of disciplinary specialization. They are not chiefly responsible for universities to become more conducive to interdisciplinary structures.

Ad 2) Looking at the examples taken by the study of the ‘Stifterverband’ to be outstanding cases of new arrangements ‘beyond the faculties’, it is apparent that all (except perhaps one – FH Lübeck) are initiated either specifically as a project (e.g. excellence cluster) in the framework of the German ‘Excellence Initiative’ or are, more indirectly, responses to pressures from science and higher education policy on the universities to develop specific profiles (e.g. the ‘interdisciplinary faculty’, Rostock University). The report concludes that the largest share of institutional structures that reach beyond disciplinary faculties is connected to external funding. In other words, these structures owe their existence to the strategies of the relevant funding agencies, the DFG, the EU, and some other less potent players (Stifterverband 2012, 33, 84). Some of the research centers, ‘special research areas’ (SFB), and ‘research units’ are funding schemes that were established already in the late 1960s in order to promote interdisciplinary research.

The crucial point for the present argument is that these schemes are mostly generated within science, that the ‘interdisciplinarity’ they attempt to establish most often remains superficial, i.e. it seldom leads to new structures beyond the time of funding. Most often the themes of the units in question are defined by the scientists themselves, and it is difficult to separate intellectually justified topics from collaborations that are entered opportunistically by adapting to the funders’ objectives.

Ad 3) When Michael Gibbons and co-authors published their book on 'the new production of knowledge' in 1994, it met with a mix of enthusiasm and critique because the seemingly radical thesis of a shift from the traditional self-referential knowledge production (Mode 1) to an institutionally dissipated one (Mode 2) was largely based on impressionist evidence and wishful thinking (Gibbons et al., 1994). But over the nearly two decades since then, the authors' normative stance has been corroborated at least to some extent by real developments. In many fields (exemplars are bio- and nanotechnology, genomics and climate modeling) research has moved from the understanding of fundamental laws to an engineering approach and/or the instrument-driven automated production of data. The economic, political, social

and/or ethical implications of some of these research lines have assumed such immediacy that something akin to the socio-technological or ecological engineering Jantsch envisaged for the purposive function of the universities may have become more realistic.

The changes in the political environment of science and the universities in particular point in the same direction. The most visible challenge for the universities is the political pressure to contribute to economic innovation by taking on a 'third mission', i.e. improving knowledge transfer and getting directly involved in economic activity. Another challenge is that they become accountable to the democratic polity both by making the internal procedures transparent by which the scientific community ascribes reputation based on achievement and by legitimating the social relevance of the research output. All across Europe legislatures have mandated that universities establish 'governing boards', in part diffusely emulating the U.S. example, in part responding to expectations of communities, regions and/or economic stakeholders that call for 'value for money', be it economic or political. Societal and political legitimacy has become a new challenge in the universities' environments even if the ways in which the expectations are formulated may be diffuse and indirect, sometimes even generated by themselves in the form of self-representation.

In any case, the increased urgency of these external expectations addressed to science in general and the university in particular has an important implication that differentiates them from most of (though not all) previous attempts by funding agencies to initiate and promote interdisciplinary research: the self-referentiality of disciplines is complemented by the central administration's orientation to the university's outside publics. Interdisciplinarity is thus given a specific function in the new mode of knowledge production if and insofar the universities as strategic actors represented by their leadership give concrete meaning to these expectations and mold them into research programs.

4. Interdisciplinarity as an organizational problem of universities

It has often been diagnosed that the resistance of universities to change is caused by the social structure of disciplines. The disciplines are connected to the organizational structure of departments (or faculties), they are the basis of their mutual reinforcement and their remarkable resilience across time and space (Sá 2008, 539). The crucial references of departments and their members transcend the individual university. These are the disciplines as intellectual and social organizations with extended ties to respective labor markets (some more clearly defined and protected by accreditations than others). The autopoietic nature of disciplines assures their perennial and, in principle, their unlimited regeneration, growth and

differentiation. Professors' allegiance is to their disciplinary and specialties' communities, i.e. in the context of the university, to their departments. "Their primary focus outside the university is their reputation compared with that of comparable departments at other universities. Furthermore, their concerns focus on the policies of their respective disciplinary and parallel professional associations. However, they are not concerned with the university's contribution to community service, the politics and economics of the city or the region where the university is located. They are usually not concerned with the university's politics and representation to the non-academic world at all, except where they touch upon their immediate interests" (Weingart 2013, 8). Clark posed the question how universities can become 'entrepreneurial', in the sense of gaining the capacity to act as an organization and by becoming responsive to their environments improve and secure their legitimacy? In other words, as Clark diagnosed: the universities' "response capabilities" are diminishing as external demands grow (Clark 2000,12).

The changes, inside and outside science and its foremost institution, have resulted in new *organizational challenges* that are in conflict with this structural conservatism of the disciplinary university. A few of them should be mentioned here. If one takes the obstacles to the establishment of structures 'beyond faculties' such as interdisciplinary research centers as test case the following, on different levels, may be identified: 1) *allocation of funds* which are determined by departmental development strategies. Within the context of a university, departments compete with one another for funds. Development strategies which serve to legitimate claims to such funds cannot be compared with one another. Thus size, the amount of external funding, outside reputation (that also escapes comparison) and a vague perception of a subject's general relevance (medicine and engineering rank higher than the social sciences and humanities) are condensed to an implicit ranking of 'power' against which interdisciplinary centers rarely ever have a chance to prevail in budgetary conflicts; 2) *recruiting processes* work very similarly. In most cases interdisciplinary units or centers rely on the dual membership of professors in these centers *and* in departments. Recruiting is determined mostly by the departments. They legitimate recruiting decisions with disciplinary 'quality standards' rather than with reference to the centers' interdisciplinary topic and the requisite competencies. Part of the justification is also the time scale as departments usually have a longer lifetime than interdisciplinary centers; 3) *teaching* is commonly organized within departments in disciplinary curricula. Interdisciplinary organizations are often prevented from offering courses and/or degrees. This makes their members dependent on departmental policies; connected to this is 4) the *labor market* that as far as professional jobs

are concerned is organized along disciplinary lines with disciplinary certificates being the precondition to entry. Typically, students interested in work in interdisciplinary thematic fields are discouraged by the lack of career opportunities; 5) *modes of accounting and evaluation* that have been introduced into higher education systems everywhere during the last two decades are reinforcing disciplinary structures because virtually all of them are based on indicators that are surrogates of the internal communication process of science and disciplines in particular. "Their effect as incentives to the behaviour of professors and researchers is one of reinforcement rather than re-direction" (Weingart 2013).

The list of obstacles to the implementation of interdisciplinary research and teaching may not be complete but the issues mentioned illustrate the 'lock-in' in which universities find themselves even if their leaders would like to orient them to interdisciplinary 'missions'.

How deep the mechanisms reach is revealed by the following. In order to strengthen university central administrations in Germany, university presidents and rectors were granted considerable competencies by new higher education laws to act in entrepreneurial fashion. However, a study that looked recently at six universities' reactions to outside evaluations found a most striking fact: in spite of the new powers given to the university leaders the system is still significantly less hierarchical and centralized than its counterparts in other European countries, notably the UK. Most importantly, *differences between disciplinary cultures generate academic non-aggression pacts and threaten central efforts at structural change by questioning their legitimacy*. Often enough the central administrations, presidents in particular, shy away from conflicts and abstain from structural reforms (Gläser, v. Stuckrad 2011). Similarly Sá observes: "Despite the multiplication of interdisciplinary ORUs (organized research units – PW) overtime, some observers are frustrated by the lack of administrative leadership in bringing about organizational change to facilitate interdisciplinarity in universities" (Sá 2008, 542).

The means to overcome these obstacles are mostly fairly obvious: interdisciplinary centers have to be given greater autonomy, especially in the form of an independent budget. Recruiting processes have to be protected against interventions from departments with competence for the research problems in question as decisive criterion of quality rather than abstract disciplinary competence. Rhoten in her systematic study of interdisciplinary centers concludes: "Interdisciplinary centers need not only to be well-funded but to have an independent physical location and intellectual direction apart from traditional university departments. They should have clear and well-articulated organizing principles—be they problems, products, or projects—around which researchers can be chosen on the basis

of their specific technical, methodological, or topical contributions, and to which the researchers are deeply committed. While a center should be established as a long-standing organizational body with continuity in management and leadership, its researchers should be appointed for flexible, intermittent but intensive short-term stays that are dictated by the scientific needs of projects rather than administrative mandates" (Rhoten 2003, 9). Centers should also be given the right to confer degrees at least on the doctoral level so as to avoid anticipatory strategies of adaptation to disciplinary standards. Finally, performance measures should be constructed in such a way that they do not reproduce disciplinary reputational structures.

The 'depth' of the institutional reach of disciplinarity is impressive and constantly self-reinforcing. In fact, the entire system of generation and distribution of reputation in science, i.e. the mechanism that makes science an autopoietic social system, is organized around disciplines. There is no internal mechanism to bring about change except that the system evolves in such a way that it may become unsustainable.

5) New forms of knowledge production? The emergence of an external public

While so much stands in the way institutionally for interdisciplinary forms of research and teaching to be realized in universities, the discourse about the drawbacks and potentials, about the obstacles and opportunities is itself an indicator of a process of change. The causes of this discourse are probably manifold and its endpoint is far from clear. In order not to be caught in momentary hypes or lost in the confusing abundance of detail, it helps to take a step back to get a perspective on the greater picture. Robert Frodeman does just that by pronouncing the end of the age of disciplinarity as the dominating regime of knowledge production (Frodeman, this volume). He correctly points out that disciplines are a creation of the 19th century. In a similar vein Paul Forman writes: "As a distinct cultural constellation disciplinarity began to take shape only toward the end of the eighteenth century. It attained clear articulation and concerted implementation only in the nineteenth century, and even then was realized only slowly and imperfectly. The triumph of disciplinarity as a hegemonic cultural ideal came about during the fifty years following the First World War. Toward the end of that half century, in the two decades following the Second World War, disciplinarity was almost universally regarded as the inevitable, as well as the most estimable, mode of knowledge production. Once attained, it was supposed necessarily to remain—in perpetuity, the end of history" (Forman 2012, 59). Each author, for different reasons, sees the end of the disciplinary mode of knowledge production, if not yet realized at least on the horizon.

Foreman argues as a cultural historian. He sees the shift from modernity to post-modernity as underlying the end of the traditional disciplines – not necessarily the coming of interdisciplinary knowledge production. Fundamental changes of four cultural values: proceduralism, disinterestedness, autonomy, and solidarity signify the shift. "Those four values, together with the high value placed on discipline itself, created disciplinarity as the ideal form of knowledge production and curation in modernity" (Forman 2012, 72). Forman then analyzes how each value has fared in the transition to post-modernity, and how, disciplinarity in particular, has gradually assumed a pejorative connotation. Beginning in the late 1960s "university professors and university administrators; officers of funding organizations, both private and public; government officials, both legislative and executive—all have increasingly disparaged disciplines in thought and word" (Forman 2012, 92).

Frodeman comes to a very similar diagnosis, albeit based on a different set of indicators. He identifies a "current crisis of the disciplinary academy" caused by three developments: the spread of web-based education at radically reduced cost before the background of booming costs of higher education; the rise of neoliberal political philosophies and with it the end of a non-economic legitimation of higher education; universities' loss of control over the creation and dissemination of knowledge which may ultimately also mean the loss of control over certification of knowledge (cf. Frodeman, this volume).

There are other factors that add to these. Universities no longer just turn out young academics for replenishment of their own ranks, for research and the professions, i.e. doctors, lawyers, teachers, but with 50% of every age cohort they train qualified personnel for a broadly defined labor market that is differentiated way beyond the range of disciplines. The large array of courses to be found at universities is only in part a reflection of the development of knowledge, but in part also responds to the needs of a highly dynamic labor market. Thus, the teaching programs of universities already convey a large share of 'know-how' knowledge rather than the disciplinary 'know-why', as Jantsch predicted. A side effect is the loss of the elevated social status of science as an institution and of scientists as a collective.

Yet another factor contributing to this is the close observation of science by the media. Partly because of the 'news value' of certain research results, partly due to the publicity sought by universities for PR purposes to legitimate themselves, media attention has revealed the normality, internal disagreements, uncertainties and limitations of science. Scientists and their institutions speak on their own behalf, act as interested parties whether in defense of their immediate interests (e.g. financial support) or to promote political positions (e.g. climate

change). This is the factual basis of the demise of 'disinterestedness' as a fundamental value attached to science, as diagnosed by Forman (Forman 2012).

To fully understand the gravity of the change in progress, it helps to recall that the ideal of disciplinary science and thus the peak of its institutionalization had been reached immediately after WWII when, supported by the ideological polarization between the capitalist West and the socialist Eastern block, a new regime of science was established. It was characterized by the separation between an academic 'basic research' sector, mainly located in the universities, and the remaining component of 'applied' research performed in industrial and government laboratories. In this regime the generation and distribution of reputation resided almost exclusively in the 'academic' part of the system, backed by the legitimation of 'basic research' as being the basis of the innovation process. Basic research was to be free from any political intervention, following 'internal', i.e. disciplinary criteria of relevance only, thereby creating a stock of knowledge from which later on practical applications could accrue. Basic, self-regulated research in the universities was – and still is – in principle both: socially and politically insulated, communicating only within and to the academic community and it is legitimated with the promise to add to the common good and welfare (cf. Frodeman, this volume).

This arrangement was 'fragile' and was criticized from early on (Guston, Kenniston 1994; Price 1967). Although the promise of science's contribution to economic and social welfare was by and large fulfilled, the connection is still difficult to communicate. But more importantly, in the late 1960s the hitherto untroubled belief in science's contribution to the commonweal began to be clouded by the realization of its risks. It took roughly another two decades – until the end of the Cold War in 1989 – for the ideological support of the contract to disperse. Since then the expectation of science to contribute more directly to social concerns, to technological innovation and to economic growth has become steadily more pronounced. As Frodeman points out, this amounts to nothing less than to cancel the internal mechanism of self-direction. This happens, for example, in the form of funding agencies and research councils applying 'broader impact' as a criterion of evaluation of research on a par with 'intellectual merit' as has happened in the UK, the EU and now in the U.S. *Applied seriously this will eventually break the monopoly of disciplinary peer review and establish 'society' as a 'relevant public', represented by the policies of the funding agencies.* In principle, insofar as the 'external public's' expectations in the form of specified objectives, or particular problems or values are formulated, they may become orienting references for research.

The structure of disciplines has never been fixed but has developed ever since disciplines became the primary organizational mode of academic knowledge production. Not only do disciplines differentiate internally, they also expand and integrate new subject matters. But it is not likely that the disciplinary mode would be replaced altogether. External 'challenges' would rather, as happens already, be incorporated into the organization of knowledge production, constituting new fields of systematic research effort, with boundaries different from the classical disciplines but subject to specialized methods of analysis, to the epistemic rigor constitutive of science and, thus, to 'disciplined' study nonetheless. If the new structural units in universities that are supposed to make research more responsive to these challenges are mere 'window dressing' exercises serving to secure legitimacy or if they actually constitute new research lines and respond to concrete problems depends on both the intellectual accessibility (and delineation) of the problem *and* the organizational provisions to integrate the research into the university.

Conclusion

The inescapable question in light of these diagnoses is: how far along the way towards a new mode of knowledge production are we? Or as Rhoten puts it: "Interdisciplinarity: trend or transition?" pointing out that:" the fact is, universities have tended to approach interdisciplinarity as a trend rather than a real transition and to thus undertake their interdisciplinary efforts in a piecemeal, incoherent, catch-as-catch-can fashion rather than approaching them as comprehensive, root-and-branch reforms" (Rhoten 2005, 6). The very historicity of the disciplinary mode of knowledge production makes it highly improbable that it will remain the same forever. But that does not necessarily mean that the new mode is just around the corner. Some two decades ago the announcement of the advent of a 'Mode 2' of knowledge production or of 'post-normal science', although premature at the time, received remarkable attention (Gibbons et al. 1994; Funtowicz, Ravetz 1993). Within the academic community it met with much scepticism, pointing to the lack of empirical evidence and to the 'normative stance' of the claims (Hessels, van Lente 2008).[4] However, much of the positive reception came from outside academia, i.e. from the science policy community. Rhoten "found substantial evidence of *extrinsic* attention to interdisciplinary research in the discourses and resources of government agencies, policy makers, scholarly associations, and university administrators" (Rhoten 2005, 8). The applause with which the latter greet predictions of the advent of a new age of interdisciplinarity is a reflection of their distrust of

[4] Hessels and van Lente give a full overview of the debate over Mode1/Mode2.

the existing system of academic knowledge production, especially in the universities, as much as it reacts to its intractability and its distance from society. Thus, the conflict between a scientific community shielding itself from expectations of immediate relevance and a science policy community representing just these expectations as those of a broader public is being replayed. Only now it has become more acute than before in that some universities take concrete organizational measures. It is too early to judge if they mark the beginning of a transition or will remain just a trend.

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